

Mir crew installs new motion control computer

Crews exchange record amount of supplies

New surface contamination device delivered

By John Lawrence

Russia's Mir Space Station was the recipient of benefits from Phase 1 cooperation with the United States this week as *Atlantis* delivered a record amount of equipment and supplies, including a replacement computer.

During six days of docked operations, the spacecraft crews exchanged 10,440 pounds of material. The amount included 197 resupply items (5,985 pounds) and 17 containers of water (1,717 pounds).

One of the more significant items was a replacement motion control computer. The station's primary motion control computer failed Sept. 14. A backup was retrieved from on-orbit storage, but failed to perform reliably. By stringing together the healthy components of the two faulty computers, the cosmonauts were able to jury-rig a working system that kept the station stable through docking.

After docking, the shuttle orbiter assumed attitude control of the combined *Atlantis*/Mir complex. On the third day of docked operations, Solovyev and Flight Engineer Pavel Vinogradov installed the new motion control computer in Mir's Core Module. Installation and checkout went smoothly, enabling Russian flight controllers to begin the uplink of fresh software.

The Russians also took advantage of *Atlantis*' presence to replace an onboard command exchange unit that acts as a relay between Mir's main motion control computer and the Kvant module's gyrodynes and Kurs antenna to provide increased confidence in Mir's attitude control capability.

Atlantis will bring back 64 U.S. items (1,832 pounds) and 42 Russian items (905 pounds).



A new NASA device to monitor the structural health of the future International Space Station was delivered to the Russian Space Station Mir for testing by *Atlantis* on STS-86.

The Space Portable Spectroreflectometer, a device for measuring the effects of the space environment on spacecraft materials, is designed to test spacecraft materials such as those being used to construct the international station.

"The Spectroreflectometer is the first hand-held, battery-powered device of its kind," said principal investigator Ralph Carruth of Marshall Space Flight Center. "It will allow astronauts to monitor and assess the condition of actual spacecraft surfaces."

During a space walk planned for later this

year, Russian cosmonauts and a U.S. astronaut will use the device to measure how much energy can be absorbed by the thermal control coatings, or radiator surfaces, of Mir.

"Radiators, where excess heat is dumped from the space station, are a vital part of the spacecraft's cooling system," said Jim Zwiener, co-investigator for the device. "If the radiators degrade, the cooling system degrades, so these are critical surfaces."

Measurements will be used to determine the deterioration of radiator surfaces caused by the space environment and the effects of gases released from the spacecraft that collect on the spacecraft's surfaces. To take measurements, the device will be held against the space station's surface at four sites for about two minutes.

The Space Portable Spectroreflectometer was built for NASA by AZ Technology Inc.

Columbia next in line in November

By Ed Campion

Once *Atlantis* was launched on STS-86, the prime focus at KSC shifted to the final flight scheduled for 1997—*Columbia*'s on Mission STS-87.

The twenty-fourth flight of NASA's oldest orbiter will be highlighted with the deployment and retrieval of the SPARTAN-201 satellite, operations with the United States Microgravity Payload, making its fourth flight and a space walk to demonstrate International Space Station assembly and maintenance operations.

Columbia is currently in the Orbiter Processing Facility bay 2, undergoing final processing work before its scheduled rollover to the Vehicle Assembly Building around Oct. 20. Launch remains targeted for 1:46 p.m. CST Nov. 19.

As *Atlantis* and Mir orbited the Earth together, preparations also were under way for the final two shuttle-Mir missions to be flown by *Endeavour* and *Discovery*.

Endeavour, in Orbiter Processing Facility bay 1, is being prepared for STS-89 in mid-January, and *Discovery* is being readied for launch in late May 1998 on STS-91, the final shuttle-Mir mission.



NASA Electronic Photo STS086E5355

TOTE THAT BALE—STS-86 Mission Specialist Wendy Lawrence moves supplies between the Space Shuttle *Atlantis* and Mir Space Station on Sept. 30 during the seventh *Atlantis*/Mir docking mission. The two crews transferred a record amount of supplies during six days of docked operations, including a replacement motion control computer for the Russian station. Among items moved from Mir to *Atlantis* were the old Elektron oxygen-generating unit, a beetle experiment that studied changes in circadian rhythms, and biomedical experiment equipment and samples.

Mars Pathfinder exits rock garden to begin long trek

After 83 days of atmospheric, soil and rock studies, NASA's Mars Pathfinder is moving into extended mission activities that will take the rover on its longest trek yet, while the lander camera completes its biggest and best landscape panorama.

"The lander and rover performance continues to be nothing short of extraordinary," said Brian Muirhead, Mars Pathfinder project manager at NASA's Jet Propulsion Laboratory. "We have proven that we know how to design robust robots to operate in the hostile environment of Mars."

The rover has completed its last alpha proton X-ray spectrometer study for a while, taking compositional measurements of a rock nicknamed Chimp, just behind and to the left of an area scientists call the Rock Garden. Once data from the spectrometer was retrieved, Sojourner began a 164-foot clockwise stroll around the lander to perform a series of technology experiments and hazard avoidance exercises.

Meanwhile, the Pathfinder lander camera is continuing to image the Martian landscape in full-resolution color as part of its goal to provide a "super panorama" image of the Ares Vallis landing site. Each frame of this panorama is imaged using 12 color filters plus stereo.

"The super pan will be our biggest and best imaging data product," Muirhead said. "It is made up of 1 gigabit (1 billion bits) of data, of which we've received more than 80 percent. Given our limited downlink opportunities, we should have the full image by the end of October."

The 22-pound rover has survived 10 times longer than its primary mission design of seven days, while the lander has now been operating 2.5 times longer than it was originally expected to operate, according to

Richard Cook, Mars Pathfinder mission manager.

Both vehicles are solar-powered, but carried batteries to conduct night-time science experiments and keep the lander warm during the sub-freezing nights on Mars. Normal usage has fully depleted the rover's non-rechargeable batteries, limiting it to daylight activities only. The lander battery, which packed more than 40 amp-hours of energy on landing day, performed perfectly during the 30-day primary mission, but is now down to less than 30 percent of its original capacity.

"We expected to begin seeing this type of degradation on both vehicles and, of course, designed both the lander and rover to operate without batteries altogether," Cook said. "If everything else continues to operate properly, we could continue conducting surface experiments for months."

About once every two weeks, the lander battery is used to perform some night-time science experiments, he added. The primary activity is acquiring meteorological data and images of morning clouds, as well as images of Mars' two small moons, Phobos and Deimos.

Despite the lack of battery power, the rover has continued taking successful spectrometer readings during the day. In the next two weeks, engineers will drive the vehicle back to a magnetic target on the ramp from which Sojourner first touched Martian soil.

"This analysis of the dust on the ramp magnet is a very important science measurement," noted Dr. Matthew Golombek, Mars Pathfinder project scientist. "The results should give us a clue about how all this magnetic dust was formed."

Recent images and movies from Mars Pathfinder activities are posted to the Internet at: <http://marsweb.jpl.nasa.gov>

NASA names X-33 launch, landing sites

NASA has released the final environmental impact statement on the development and flight testing of the X-33 Advanced Technology Demonstrator and identified launch and landing sites.

The 273,000-pound, wedge-shaped X-33 is being developed under a cooperative agreement between NASA and Lockheed Martin Skunk Works, Palmdale, Calif., that began in 1996. It is a sub-scale technology demonstrator prototype of a Reusable Launch Vehicle, which Lockheed Martin has named "Venture Star," and which the company hopes to develop early in the next century.

Through demonstration flights and ground research, the X-33 will provide information needed for industry to decide by the year 2000 whether to proceed to the development of a full-scale, commercial single-stage-to-orbit reusable launch vehicle. Such a vehicle could lower the cost of putting a pound of payload into space from \$10,000 to \$1,000.

The environmental study considers issues such as public safety, noise, impacts on general aviation and effects on biological and natural resources. In the document NASA named three preferred landing sites and one preferred launch site for the X-33. Seven sites were evaluated

for potential use during the 14-month study.

The preferred launch site is located near Haystack Butte on the eastern portion of Edwards Air Force Base, Calif. The preferred landing sites identified are Silurian Lake, a dry lake bed near Baker, Calif.; Michael Army Air Field, Dugway Proving Ground, Utah; and Malmstrom Air Force Base near Great Falls, Mont.

"The study determined that the overall predicted environmental impacts of X-33 were minimal at all sites considered," said Dr. Rebecca McCaleb, director of environmental engineering and management at Marshall Space Flight Center.

Space station technology to bring expert medical care to remote areas

Soon people who do not live in or near large cities with major medical facilities will have expert medical care readily available.

Patients in remote or medically underserved areas of the country will benefit from an experiment in advanced telemedicine conducted jointly by NASA's Lewis and Ames Research Centers, and James D. Thomas, M.D., FACC, of The Cleveland (Ohio) Clinic Foundation.

Recently, a "patient" undergoing an echocardiographic examination at Lewis was "remotely" diagnosed by Thomas at Ames. He viewed a real-time display of echocardiographic video images transmitted over the broadband NASA Research and Education Network. Thomas interactively guided the technician

administering the procedure through a two-way voice link between the two sites.

"I was very pleased with the diagnostic quality of the echocardiograms," Thomas said. "Digital echocardiographic equipment will be on the International Space Station when it is operational. Echocardiography is more practical for life in space than other imaging techniques, such as magnetic resonance imaging (MRI) because it requires less power, is noninvasive, is small and versatile, and is not magnetic or radioactive. The early results of our experiment support our belief that this technology holds great promise for use in space as well as use on Earth by means of telemedicine."

Echocardiography is a medical

technique that applies the methods of ultrasound imaging to the cardiac system, providing a "motion picture" of the heart in action. A small, rural clinic may have access to an echocardiograph machine but not to a technician specially trained in its operation, or to a staff cardiologist. If the clinic were connected to a major metropolitan medical facility through a high-speed communications network, a minimally trained technician could carry out the procedure under the supervision and guidance of qualified echocardiography personnel.

While many telemedicine requirements can be satisfied by the transmission of still images (e.g., X-ray photographs), the challenge of procedures such as echocardiography

is that high-resolution, moving images must be transmitted in real time. This requires a reliable broadband network and a robust data-compression mechanism.

"In the demonstration, we used the NREN to assess the clinical feasibility of conducting remote echocardiography, as well as the technical feasibility of supporting remote echocardiography, by determining the minimum network needed and the maximum video compression required to produce a transmission of high-resolution medical imagery," said Christine Falsetti, NREN project manager at Ames.

The NASA Research and Education Network is NASA's cornerstone project of the interagency Next Generation Internet initiative. In